
EVALUATION OF CROSS SECTIONS FOR NEUTRONS AND PROTONS UP TO 3 GeV ON $^{12,13}\text{C}$

Yukinobu Watanabe¹, Weili Sun², Kazuaki Kosako³, Efrem S. Sukhovitskii⁴,
Osamu Iwamoto⁵, Satoshi Chiba⁵, Tokio Fukahori⁵

¹ *Kyushu University*

² *Institute of Applied Physics and Computational Mathematics*

³ *Sumitomo Atomic Energy Industries, Ltd.*

⁴ *Joint Institute of Energy and Nuclear Research - Sosny*

⁵ *Japan Atomic Energy Research Institute*

High-energy neutron and proton nuclear data for carbon are requested with high priority in various applications, such as shielding design of accelerator facilities, dose evaluation in cancer therapy with neutron and proton beams, efficiency calculation of neutron detectors, and nucleosynthesis prediction of light elements, Li, Be, and B. We have performed an evaluation of cross sections on $^{12,13}\text{C}$ for both neutrons and protons in the incident energy range extended up to 3 GeV in order to meet the above nuclear data needs. The evaluation is based on predictions from nuclear model calculations and systematics as well as measurements. A nuclear model calculation code system is developed using the GNASH code for energies below 150 MeV and the JQMD code for those above 150 MeV. The evaluated cross sections contain the following data: neutron total cross sections, nucleon elastic scattering cross sections and angular distributions, non-elastic cross sections, production cross sections and double-differential cross sections of secondary light particles (n , p , d , t , ^3He , α , and π), and isotope production cross sections. The results are compared with available experimental data and the LA150 evaluation. For validation of these nuclear data, thick-target neutron production spectra from carbon target are calculated for bombardment of 113 MeV and 256 MeV protons using the MCNPX transport code and are compared with the measurements. These evaluated nuclear data are included into the JENDL high-energy file.